PB-251 782

MOSQUITO CREEK RESERVOIR, TRUMBULL COUNTY, OHIO

Pacific Northwest Environmental
Research Laboratory

Prepared for:

National Environmental Research Center

June 1975

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1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Report on Mosquito Creek Reservoir, Trumbull County, Ohio		5. REPORT DATE Prepared June, 1975 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Anonymous (National Eutrophication Survey Staff)		8. PERFORMING ORGANIZATION REPORT NO. Working Paper #406
9. PERFORMING ORGANIZATION NAME AND ADDRESS National Eutrophication Survey U.S. Environmental Protection Agency 200 S. W. 35th St. Corvallis, Oregon 97330		10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Office of Research and Development U.S. Environmental Protection Agency 401 M Street, S. W. Washington, DC 20460		13. TYPE OF REPORT AND PERIOD COVERED Final - 1973 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES
Prepared in cooperation with the U.S. Environmental Protection Agency, National Environmental Research Center, Las Vegas, Nevada 89114

16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
eutrophication lakes nutrients phosphorus nitrogen loading		05B 05C

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
Release unlimited		37 pp.
	20. SECURITY CLASS *(This page)*	22. PRICE 4.00

EPA Form 2220-1 (9-73)

PB 251 782

U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT

ON

MOSQUITO CREEK RESERVOIR

TRUMBULL COUNTY

OHIO

EPA REGION V

WORKING PAPER No. 406

PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

An Associate Laboratory of the

NATIONAL ENVIRONMENTAL RESEARCH CENTER - CORVALLIS, OREGON

and

NATIONAL ENVIRONMENTAL RESEARCH CENTER - LAS VEGAS, NEVADA

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REPORT
ON
MOSQUITO CREEK RESERVOIR
TRUMBULL COUNTY
OHIO
EPA REGION V
WORKING PAPER No. 406

WITH THE COOPERATION OF THE
OHIO ENVIRONMENTAL PROTECTION AGENCY
AND THE
OHIO NATIONAL GUARD
JUNE, 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprenensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Ohio Environmental Protection Agency for professional involvement, to the Ohio National Guard for conducting the tributary sampling phase of the Survey, and to those Ohio wastewater treatment plant operators who provided effluent samples and flow data.

Ned Williams, Director, and Tom Birch, Ken Carr, Larry Dietrick, Ron Havlice, Larry Korecko, Rod Mehlhop, Terry Wheeler, and John Youger, Ohio Environmental Protection Agency, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

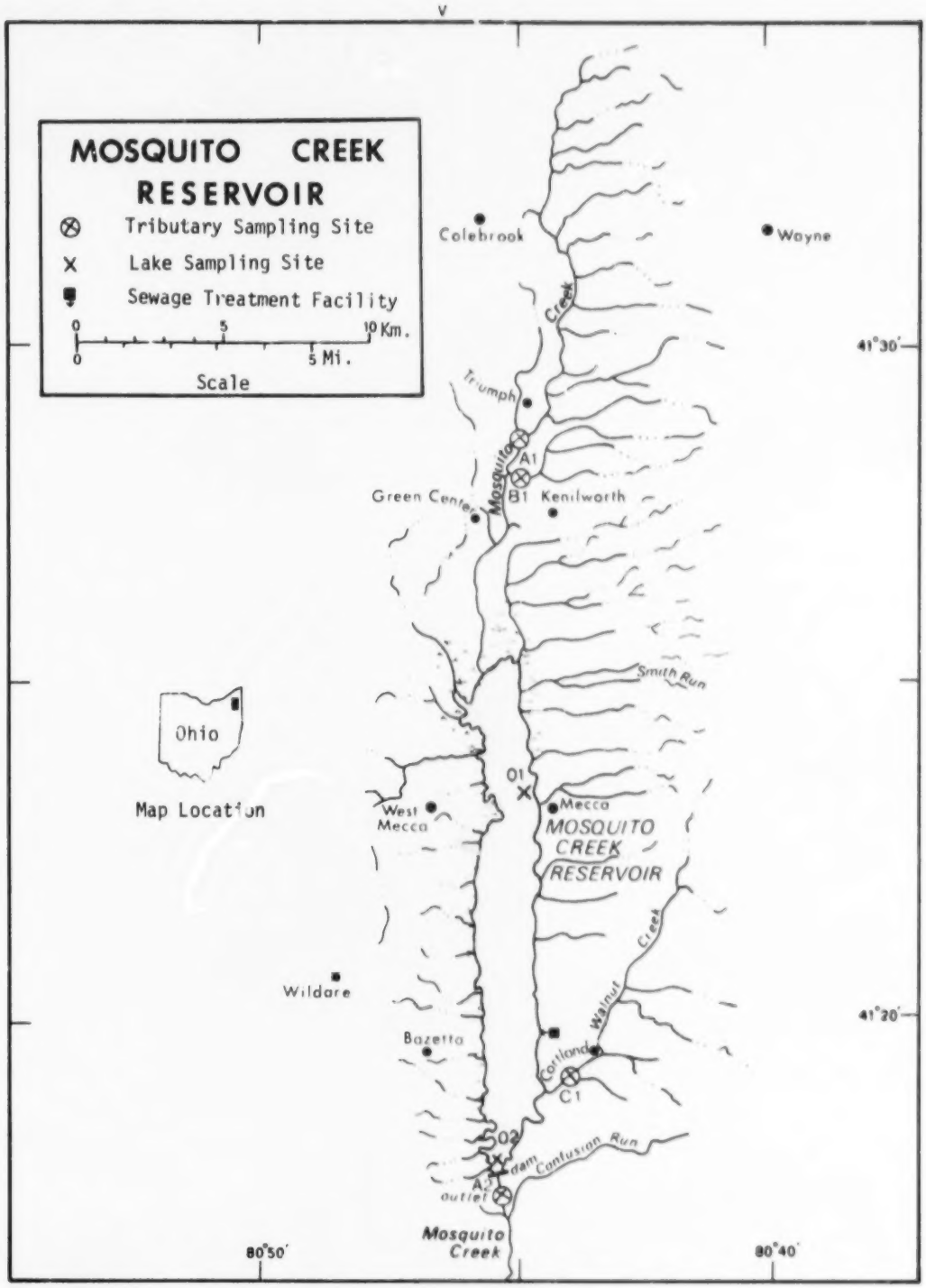
Major General Dana L. Stewart, then the Adjutant General of Ohio, and Project Officer Lt. Colonel Robert C. Timmons, who directed the volunteer efforts of the Ohio National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF OHIO

LAKE NAME	COUNTY
Atwood	Carroll, Tuscarawas
Beach City	Stark, Tuscarawas
Berlin	Mahoning, Portage, Stark
Buckeye	Fairfield, Licking, Perry
Charles Mill	Ashland, Richland
Deer Creek	Fayette, Pickaway
Delaware	Delaware
Dillon	Muskingum
Grand Lake of St. Marys	Auglaize, Mercer
Grant	Brown
Holiday	Huron
Hoover	Delaware, Franklin
Indian	Logan
Loramie	Auglaize, Shelby
Mosquito Creek	Trumbull
O'Shaughnessy	Delaware
Pymatuning	Ashtabula, OH; Crawford, PA
Pleasant Hill	Ashland, Richland
Rocky Fork	Highland
Shawnee	Greene
Tappan	Harrison


MOSQUITO CREEK RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
0 5 10 Km.
0 5 Mi.
Scale
Ohio
Map Location
Colebrook
Wayne
Triumph
Mosquito Creek
A1
B1 Kenilworth
Green Center
Smith Run
O1
West Mecca
Mecca
MOSQUITO CREEK RESERVOIR
Walnut Creek
Wildare
Bazetta
Cortland
C1
O2
dam
Confusion Run
A2
outlet
Mosquito Creek
41°30'
41°20'
80°50'
80°40'

MOSQUITO CREEK RESERVOIR

STORET NO. 3921

I. CONCLUSIONS

A. Trophic Condition:

Survey results indicate that Mosquito Creek Reservoir is eutrophic. This lake ranked second when the 20 Ohio lakes sampled in 1973 were compared using a combination of six parameters*. Five lakes had less median total phosphorus, one had less and one had the same median dissolved phosphorus, none of the lakes had less inorganic nitrogen, nine had less mean chlorophyll a, and three had greater mean Secchi disc transparency. Depression of dissolved oxygen with depth occurred at both sampling stations in October.

Survey limnologists noted floating and submerged macrophytes along the shoreline and in the shallows from station 1 (north end of lake) to station 02 (south end of lake).

B. Rate-Limiting Nutrient:

There was a differential change in the primary nutrients in the assay sample such that the limiting nutrient shifted from phosphorus in the reservoir to nitrogen in the sample; consequently, the assay results are not indicative of conditions in the reservoir at the time the sample was collected (04/21/73).

The reservoir data indicate phosphorus limitation at all

* See Appendix A.

sampling times; i.e., the mean N/P ratios were 21/1 or greater, and phosphorus limitation would be expected.

C. Nutrient Controllability:

1. Point sources--The only known point source contributing to the total phosphorus load to Mosquito Creek Reservoir was the wastewater treatment plant at Cortland. This source alone contributed 36.6% of the total load reaching the reservoir during the sampling year.

The present loading of 0.32 $g/m^2/yr$ is equal to that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 11). The reservoir is definitely eutrophic, however, and the phosphorus input from the Cortland STP and other sources should be minimized to the greatest practicable extent to improve the trophic condition of the reservoir.

2. Non-point sources--During the sampling year, non-point sources accounted for 63.4% of the total phosphorus load to the reservoir. Mosquito creek contributed 12.8%, the Unnamed Creek (B-1) contributed 2.7%, and Walnut Creek contributed 6.8%. Ungaged tributaries were estimated to have contributed 35.6% of the total load.

The phosphorus export rates of the Mosquito Creek tributaries were quite low during the Survey sampling year (see page 11) and compare well with the export rates of unimpacted Ohio tributaries sampled elsewhere; e.g., the mean phosphorus export rate of the six tributaries of nearby Berlin Reservoir* was 26 $g/km^2/yr$.

* Working Paper No. 395.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 31.07 kilometers^2.
2. Mean depth: 2.7 meters.
3. Maximum depth: >6.1 meters.
4. Volume: 85.239 x 10^6 m^3.
5. Mean hydraulic retention time: 352 days (based on outlet flow).

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Mosquito Creek	57.5	0.6
Unnamed Creek (B-1)	9.8	0.1
Walnut Creek	25.1	0.2
Minor tributaries & immediate drainage -	128.5	1.5
Total	220.9	2.4

2. Outlet -

Mosquito Creek	252.5**	2.8

C. Precipitation***:

1. Year of sampling: 93.8 centimeters.
2. Mean annual: 97.8 centimeters.

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† Table of metric equivalents--Appendix B.
†† Youger, 1975.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Mosquito Creek Reservoir was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the lake and from a number of depths at each station (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 3.0 meters at station 1 and 6.1 meters at station 2.

The lake sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR MOSQUITO CREEK
STORET CODE 3421

PARAMETER	1ST SAMPLING (4/21/73) 2 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/30/73) 2 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/ 9/73) 2 SITES RANGE	MEAN	MEDIAN
TEMP (C)	10.8 - 14.0	12.6	12.6	24.0 - 24.3	24.1	24.1	17.3 - 18.0	17.5	17.3
DISS OXY (MG/L)	7.7 - 10.2	9.2	9.4	5.8 - 7.5	6.9	7.2	3.4 - 8.8	5.7	4.6
CNDCTVY (MCROMO)	240. - 270.	253.	248.	203. - 221.	211.	211.	189. - 199.	194.	195.
PH (STAND UNITS)	7.9 - 7.9	7.9	7.9	7.3 - 7.9	7.7	7.7	7.1 - 7.8	7.4	7.2
TOT ALK (MG/L)	35. - 39.	37.	37.	49. - 52.	51.	51.	43. - 48.	45.	45.
TOT P (MG/L)	0.023 - 0.040	0.033	0.034	0.049 - 0.104	0.078	0.084	0.058 - 0.203	0.110	0.085
ORTHO P (MG/L)	0.005 - 0.006	0.006	0.006	0.002 - 0.024	0.007	0.005	0.005 - 0.010	0.007	0.008
NO2+NO3 (MG/L)	0.060 - 0.110	0.080	0.075	0.060 - 0.100	0.075	0.075	0.040 - 0.050	0.042	0.040
AMMONIA (MG/L)	0.050 - 0.120	0.070	0.060	0.060 - 0.080	0.070	0.070	0.060 - 0.370	0.224	0.270
KJEL N (MG/L)	0.800 - 1.000	0.867	0.850	0.700 - 1.700	1.217	1.250	1.100 - 1.800	1.440	1.400
INORG N (MG/L)	0.110 - 0.230	0.150	0.135	0.120 - 0.180	0.145	0.150	0.100 - 0.410	0.265	0.310
TOTAL N (MG/L)	0.860 - 1.110	0.947	0.925	0.760 - 1.780	1.292	1.320	1.140 - 1.850	1.482	1.440
CHLRPYL A (UG/L)	25.7 - 32.3	29.0	29.0	40.2 - 62.1	51.1	51.1	20.7 - 36.6	28.6	28.6
SECCHI (METERS)	0.9 - 1.0	1.0	1.0	0.6 - 0.8	0.7	0.7	1.0 - 1.0	1.0	1.0

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/21/73	1. Synedra sp.	4,802
	2. Flagellates	4,524
	3. Microcystis sp.	4,365
	4. Oscillatoria sp.	1,349
	5. Asterionella sp.	714
	Other genera	8,373
	Total	24,127
07/30/73	1. Oscillatoria sp.	27,076
	2. Lyngbya sp.	14,711
	3. Stephanodiscus sp.	10,650
	4. Microcystis sp.	7,220
	5. Merismopedia sp.	6,679
	Other genera	23,014
	Total	89,350
10/09/73	1. Scenedesmus sp.	3,800
	2. Melosira sp.	2,985
	3. Cyclotella sp.	2,220
	4. Schroederia sp.	1,877
	5. Dactylococcopsis sp.	1,685
	Other genera	8,518
	Total	21,085

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/21/73	01	32.3
	02	25.7
07/30/73	01	62.1
	02	40.2
10/09/73	01	36.6
	02	20.7

C. Limiting Nutrient Study:

There was an apparent differential gain in phosphorus and nitrogen in the assay sample from the time of collection to the beginning of the assay, and the results are not representative of conditions in the reservoir at the time the sample was taken. The nutrient change resulted in a shift from phosphorus limitation in the lake to nitrogen limitation in the sample.

The reservoir data indicate phosphorus limitation at all sampling times; i.e., the mean inorganic nitrogen/orthophosphorus ratios were 21/1 or greater, and phosphorus limitation would be expected.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Ohio National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of February and April when two samples were collected. Sampling was begun in May, 1973, and was completed in April, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Ohio District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads, in $kg/km^2/year$, at station B-1 and multiplying by the ZZ area in km^2.

The operator of the Cortland wastewater treatment plant provided monthly effluent samples and corresponding flow data.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal* -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Cortland	3,000	act. sludge	1,647.7	Mosquito Creek Reservoir

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
Mosquito Creek	1,265	12.6
Unnamed Creek (B-1)	270	2.7
Walnut Creek	675	6.8
b. Minor tributaries & immediate drainage (non-point load) -	3,600	36.1
c. Known municipal STP's -		
Cortland	3,625	36.3
d. Septic tanks - Unknown	?	-
e. Known industrial - None	-	-
f. Direct precipitation** -	550	5.5
Total	9,985	100.0

2. Outputs -

Lake outlet - Mosquito Creek 5,425

3. Net annual P accumulation - 4,560 kg.

* Guesman, 1973.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/ yr	% of total
a. Tributaries (non-point load) -		
Mosquito Creek	33,415	17.3
Unnamed Creek (B-1)	7,270	3.8
Walnut Creek	14,845	7.7
b. Minor tributaries & immediate drainage (non-point load) -	95,350	49.5
c. Known municipal STP's -		
Cortland	7,710	4.0
d. Septic tanks - Unknown	?	-
e. Known industrial - None	-	-
f. Direct precipitation* -	34,085	17.7
Total	192,675	100.0

2. Outputs -

Lake outlet - Mosquito Creek 139,900

3. Net annual N accumulation - 52,775 kg.

* See Working Paper No. 175.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Mosquito Creek	22	581
Unnamed Creek (B-1)	28	742
Walnut Creek	27	591

E. Yearly Loadings:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m²/yr	0.32	0.14	6.1	1.7

Vollenweider phosphorus loadings (g/m²/yr) based on mean depth and mean hydraulic retention time of Mosquito Creek Reservoir:

"Dangerous" (eutrophic loading)	0.32
"Permissible" (oligotrophic loading)	0.16

V. LITERATURE REVIEWED

Guesman, Ralph A. (Supt.), 1973. Treatment plant questionnaire (Cortland STP). Cortland, OH.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

Youger, John, 1975. Personal communication (lake morphometry). OH Env. Prot. Agency. Columbus.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3928	ATWOOD RESERVOIR	491
2	3921	MOSQUITO CREEK RESERVOIR	483
3	3924	PLEASANT HILL LAKE	431
4	3929	BERLIN RESERVOIR	429
5	3914	HOOVER RESERVOIR	392
6	3934	TAPPAN LAKE	381
7	3927	LAKE SAINT MARYS	297
8	3932	ROCKY FORK LAKE	292
9	3906	DEER CREEK RESERVOIR	290
10	3901	BEACH CITY RESERVOIR	277
11	3915	INDIAN LAKE	266
12	3907	DELAWARE RESERVOIR	263
13	3912	GRANT LAKE	261
14	3933	SHAWNEE LAKE	249
15	3930	HOLIDAY LAKE	220
16	3905	CHARLES MILL RESERVOIR	216
17	3902	BUCKEYE LAKE	207
18	3908	DILLION RESERVOIR	206
19	3917	LORAMIE LAKE	178
20	3931	O'SHAUGNESSY RESERVOIR	173

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
3901	BEACH CITY RESERVOIR	37 (7)	21 (4)	11 (2)	84 (16)	82 (15)	42 (8)	277
3902	BUCKEYE LAKE	11 (2)	76 (14)	5 (1)	0 (0)	89 (17)	26 (5)	207
3905	CHARLES MILL RESERVOIR	26 (5)	63 (12)	37 (7)	21 (4)	11 (0)	58 (11)	216
3906	DEER CREEK RESERVOIR	53 (10)	5 (1)	63 (12)	95 (18)	63 (12)	11 (2)	290
3907	DELAWARE RESERVOIR	58 (11)	16 (3)	32 (6)	89 (17)	47 (9)	21 (4)	263
3908	DILLION RESERVOIR	16 (3)	32 (6)	42 (8)	58 (11)	53 (10)	5 (1)	206
3912	GRANT LAKE	47 (9)	58 (11)	16 (3)	32 (6)	74 (14)	34 (6)	261
3914	HOOVER RESERVOIR	87 (16)	26 (5)	89 (17)	79 (15)	32 (6)	79 (15)	392
3915	INDIAN LAKE	42 (8)	74 (14)	21 (4)	16 (3)	58 (11)	53 (10)	266
3917	LORAMIE LAKE	5 (1)	37 (7)	0 (0)	5 (1)	97 (18)	34 (6)	178
3921	MOSQUITO CREEK RESERVOIR	74 (14)	100 (19)	82 (15)	53 (10)	82 (15)	92 (17)	483
3924	PLEASANT HILL LAKE	95 (18)	68 (13)	100 (19)	63 (12)	39 (7)	66 (12)	431
3927	LAKE SAINT MARYS	21 (4)	95 (18)	26 (5)	11 (2)	97 (18)	47 (9)	297
3928	ATWOOD RESERVOIR	100 (19)	89 (17)	95 (18)	68 (13)	39 (7)	100 (19)	491
3929	HERLIN RESERVOIR	79 (15)	42 (8)	74 (14)	74 (14)	68 (13)	92 (17)	424
3930	HOLIDAY LAKE	32 (6)	53 (10)	82 (15)	26 (5)	11 (0)	16 (3)	220
3931	O'SHAUGHNESSY RESERVOIR	0 (0)	0 (0)	47 (9)	100 (19)	26 (5)	0 (0)	173
3932	ROCKY FORK LAKE	68 (13)	47 (9)	58 (11)	42 (8)	11 (0)	66 (12)	292
3933	SHAWNEE LAKE	63 (12)	11 (2)	53 (10)	37 (7)	11 (0)	74 (14)	249
3934	TAPPAN LAKE	87 (16)	84 (16)	68 (13)	47 (9)	11 (0)	84 (16)	381

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
3901	BEACH CITY RESERVOIR	0.122	1.490	489.000	10.867	11.600	0.015
3902	BUCKEYE LAKE	0.179	0.380	490.000	186.567	9.600	0.020
3905	CHARLES MILL RESERVOIR	0.127	0.465	482.555	67.144	15.000	0.011
3906	DEER CREEK RESERVOIR	0.098	2.980	470.125	9.887	13.900	0.036
3907	DELAWARE RESERVOIR	0.086	2.340	484.111	10.856	14.500	0.024
3908	DILLION RESERVOIR	0.163	1.590	481.250	27.400	14.300	0.037
3912	GRANT LAKE	0.113	0.570	486.333	40.533	12.200	0.019
3914	HOOVER RESERVOIR	0.040	1.640	462.750	13.017	14.800	0.008
3915	INDIAN LAKE	0.120	0.380	485.222	76.855	14.200	0.012
3917	LORAMIE LAKE	0.185	1.380	494.000	104.100	8.200	0.019
3921	MOSQUITO CREEK RESERVOIR	0.058	0.150	465.333	36.267	11.600	0.006
3924	PLEASANT HILL LAKE	0.036	0.455	456.833	22.850	14.700	0.010
3927	LAKE SAINT MARYS	0.148	0.200	484.167	79.150	8.200	0.014
3928	ATWOOD RESERVOIR	0.031	0.205	462.000	16.442	14.700	0.005
3929	BERLIN RESERVOIR	0.042	0.900	465.435	15.496	13.600	0.006
3930	HOLIDAY LAKE	0.125	0.575	465.333	55.350	15.000	0.034
3931	O'SHAUGNESSY RESERVOIR	0.208	3.070	479.333	5.522	14.900	0.159
3932	ROCKY FORK LAKE	0.067	0.790	473.000	38.022	15.000	0.010
3933	SHAWNEE LAKE	0.069	2.380	474.333	39.567	15.000	0.009
3934	TAPPAN LAKE	0.040	0.280	466,111	37.711	15.000	0.007

APPENDIX B

CONVERSIONS FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR OHIO 1/27/75

LAKE CODE 3921 MOSQUITO CREEK RESERVOIR

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 252.5

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3921A1	57.5	0.96	1.13	1.42	1.13	0.68	0.37	0.24	0.16	0.11	0.10	0.26	0.54	0.59
3921A2	252.5	1.42	2.44	2.69	2.44	2.80	4.28	5.18	4.96	3.06	1.47	0.96	1.25	2.76
3921B1	4.8	0.15	0.19	0.25	0.21	0.12	0.06	0.04	0.02	0.01	0.02	0.04	0.09	0.10
3921C1	25.1	0.37	0.42	0.62	0.51	0.28	0.16	0.10	0.05	0.03	0.04	0.09	0.20	0.24
3921Z1	160.1	2.38	2.75	3.79	3.06	1.81	1.08	0.68	0.37	0.28	0.31	0.68	1.36	1.54

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 252.5
SUM OF SUB-DRAINAGE AREAS = 252.4
TOTAL FLOW IN = 29.73
TOTAL FLOW OUT = 33.13

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3921A1	5	73	0.91	5	0.48				
	6	73	0.82	9	0.62				
	7	73	0.11	7	0.18				
	8	73	0.06	11	0.01				
	9	73	0.02	7	0.01				
	10	73	0.11	13	0.01				
	11	73	0.48	10	0.05				
	12	73	1.22	8	0.02				
	1	74	1.53	19	11.81				
	2	74	0.54	8	0.02	23	2.15		
	3	74	2.01	9	10.31				
	4	74	1.13	5	2.69	27	0.23		
3921A2	5	73	3.82	5	1.44				
	6	73	5.69	9	12.74				
	7	73	3.62	7	3.23				
	8	73	2.66	11	4.56				
	9	73	1.56	7	3.34				
	10	73	0.93	13	1.56				
	11	73	0.54	10	1.56				
	12	73	0.42	8	0.93				
	1	74	3.51	19	1.47				
	2	74	2.61	8	5.35	23	0.93		
	3	74	4.50	9	2.94				
	4	74	5.05	5	12.01	27	1.16		

LAKE CODE 3421 MOSQUITO CREEK RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3421M1	5	73	0.15	5	0.38				
	6	73	0.14	9	0.11				
	7	73	0.02	7	0.03				
	8	73	0.01	11	0.00				
	9	73	0.00	7	0.00				
	10	73	0.02	13	0.00				
	11	73	0.07	10	0.01				
	12	73	0.20	8	0.00				
	1	74	0.24	19	2.01				
	2	74	0.09	8	0.00	23	0.37		
	3	74	0.37	9	1.76				
	4	74	0.20	5	0.48	27	0.04		
3421C1	5	73	0.37	5	0.29				
	6	73	0.37	9	0.28				
	7	73	0.05	7	0.08				
	8	73	0.02	11	0.00				
	9	73	0.01	7	0.00				
	10	73	0.05	13	0.01				
	11	73	0.17	10	0.02				
	12	73	0.45	8	0.01				
	1	74	0.59	19	5.15				
	2	74	0.20	8	0.01	23	0.93		
	3	74	0.88	9	4.47				
	4	74	0.51	5	1.22	27	0.10		
3421Z1	5	73	2.38						
	6	73	2.41						
	7	73	0.31						
	8	73	0.14						
	9	73	0.06						
	10	73	0.34						
	11	73	1.27						
	12	73	3.11						
	1	74	3.79						
	2	74	1.27						
	3	74	5.15						
	4	74	3.30						

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APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/01/27

392101
+1 23 27.0 080 45 00.0
MOSQUITO CREEK RESERVOIR
39155 OHIO

11EPALES
3

2111202
0014 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/21	15	10 0000	14.0		36	245	7.90	35	0.060	0.800	0.060	0.006
	15	10 0006	13.7	10.2		240	7.90	35	0.050	0.800	0.060	0.006
	15	10 0010	13.0	9.2		240	7.90	35	0.060	0.900	0.060	0.006
73/07/30	09	15 0000	24.2		24	203	7.90	52	0.070	1.700	0.080	0.024
	09	15 0004	24.1	7.3		203	7.70	50	0.070	1.400	0.080	0.006
	09	15 0009	24.1	7.2		203	7.50	52	0.080	1.400	0.100	0.005
73/10/09	14	25 0000	18.0	8.8	38	189	7.80	44	0.110	1.800	0.050	0.010
	14	25 0008	17.3	3.4		190	7.20	43	0.310	1.400	0.040	0.008

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/21	15	10 0000	0.030	32.3
	15	10 0006	0.038	
	15	10 0010	0.037	
73/07/30	09	15 0000	0.104	62.1
	09	15 0004	0.090	
	09	15 0009	0.096	
73/10/09	14	25 0000	0.085	36.6
	14	25 0008	0.117	

STORET RETRIEVAL DATE 75/01/21

392102
41 16 19.0 080 45 30.0
MOSQUITO CREEK
39155 OHIO

TIEPALES 2111202
3 0023 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/21	15 40	0000	12.2		34	270	7.90	38	0.060	0.300	0.090	0.005
	15 40	0008	12.0	9.6		270	7.90	38	0.070	0.300	0.100	0.006
	15 40	0020	10.8	7.7		250	7.90	39	0.120	1.000	0.110	0.006
73/07/30	09 45	0000	24.3		32	218	7.90	50	0.060	1.100	0.060	0.002
	09 45	0005	24.2	7.5		218	7.70	49	0.060	0.700	0.060	0.003
	09 45	0019	24.0	5.8		221	7.30	51	0.080	1.000	0.070	0.005
73/10/04	14 55	0000	17.6	7.4	34	195	7.80	45	0.060	1.400	0.040	0.005
	14 55	0015	17.3	4.6		198	7.20	46	0.270	1.100	0.040	0.006
	14 55	0020	17.3	4.4		199	7.10	48	0.370	1.500	0.040	0.008

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/21	15 40	0000	0.031	25.7
	15 40	0008	0.023	
	15 40	0020	0.040	
73/07/30	09 45	0000	0.051	40.2
	09 45	0005	0.044	
	09 45	0019	0.079	
73/10/04	14 55	0000	0.059	20.1
	14 55	0015	0.083	
	14 55	0020	0.203	

APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/02/03

3921A1
41 29 00.0 080 44 50.0
MOSQUITO CREEK
39149 7.5 GUSTAVAS
1/MOSQUITO CREEK RESERVO
ST HWY 46 BRDG 0.5 MI S OF TRIUMPH
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/05	09	40	0.285	1.400	0.038	0.010	0.030
73/07/07	11	05	0.126	2.150	0.075	0.011	0.030
73/08/11	11	20	0.040	2.100	0.096	0.014	0.055
73/09/07	11	25	0.050	0.540	0.061	0.012	0.050
73/10/13	09	10	0.010K	1.250	0.042	0.010	0.050
73/11/10	11	30	0.640	0.450	0.016	0.008	0.015
73/12/08	11	30	0.660	0.500	0.016	0.016	0.025
74/01/14	11	30	1.440	1.000	0.076	0.040	0.185
74/02/08	13	30	1.700	0.800	0.025	0.015	0.050
74/02/23	11	00	1.100	0.900	0.030	0.015	0.090
74/03/09	12	00	0.600	1.200	0.030	0.020	0.240
74/04/05	10	30	0.300	1.100	0.025	0.005	0.030
74/04/27	10	30	0.080	0.800	0.015	0.010	0.045

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/03

3721A2
+1 17 43.0 080 45 26.0
MOSQUITO CREEK
39 7.5 CHAMPION
0/MOSQUITO CREEK RESERVO
ST HWY 5 BRDG 0.3 MI BELO DAN
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/05	09 00		0.024	0.930	0.042	0.005K	0.040
73/06/04	09 55		0.320	1.400	0.123	0.006	0.042
	10 45		0.800	2.100	0.076	0.032	0.060
73/07/07	09 20		0.054	2.500	0.290	0.011	0.070
73/08/11	09 30		0.028	3.000	0.200	0.008	0.070
73/09/07	09 45		0.016	1.540	0.120	0.010	0.080
73/10/13	09 00		0.034	1.700	0.147	0.011	0.100
73/11/10	14 30		0.060	0.850	0.016	0.008	0.045
73/12/08	09 45		0.084	0.700	0.036	0.016	0.055
74/01/19	09 30		0.288	0.700	0.108	0.015	0.055
74/02/08	12 00		0.440	0.800	0.020	0.010	0.065
74/02/23	09 30		0.340	0.900	0.035	0.005	0.050
74/03/09	09 00		0.290	0.800	0.015	0.005K	0.075
74/04/05	09 00		0.290	1.100	0.025	0.005	0.030
74/04/27	09 00		0.032	0.900	0.025	0.045	0.100

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/03

392151
41 28 20.0 080 44 50.0
UNNAMED CREEK
39 7.5 GUSTAVAS
T/MOSQUITO CREEK RESERVO
ST HWY 46 BRDG 0.6 MI N OF GREENE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/05	09 48		0.470	0.920	0.056	0.011	0.030
73/06/04	10 30		0.350	1.400	0.170	0.027	0.062
73/07/07	10 30		0.370	2.100	0.170	0.027	0.075
73/08/11	10 00		0.014	2.600	0.078	0.031	0.175
73/09/07	10 44		0.073	1.260	0.750	0.079	0.230
73/10/13	10 30		0.022	1.900	0.084	0.020	0.090
73/11/10	11 00		1.340	0.800	0.016	0.008	0.015
73/12/08	11 00		1.200	0.400	0.016	0.016	0.016
74/01/19	11 00		2.300	1.200	0.092	0.045	0.150
74/02/04	13 00		1.340	0.700	0.030	0.010	0.030
74/02/23	12 00		2.600	0.900	0.040	0.015	0.065
74/03/04	10 00		1.360	1.100	0.025	0.020	0.100
74/04/05	10 00		0.290	0.900	0.025	0.025	0.095
74/04/27	10 00		0.330	1.000	0.040	0.015	0.020

STORET RETRIEVAL DATE 75/02/03

3421C1
41 19 30.0 080 43 55.0
WALNUT CREEK
39 7.5 CORTLAND
T/MOSQUITO CREEK RESERVO
ST RAY 45 BRDG IN SE CORTLAND
11EMALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/05	09	10	0.470	1.500	0.046	0.058	0.085
73/06/04	10	10	0.126	1.320	0.052	0.040	0.100
73/07/07	09	50	0.500	1.480	0.068	0.063	0.095
73/08/11	10	00	0.198	2.200	0.052	0.058	0.090
73/09/07	10	15	0.300	1.490	0.044	0.086	0.110
73/10/13	09	15	0.020	1.900	0.078	0.056	0.130
73/11/16	10	30	0.450		0.016	0.032	0.050
73/12/08	10	00	0.588	0.700	0.020	0.048	0.051
74/01/14	10	00	1.200	0.900	0.088	0.045	0.180
74/02/08	12	45	0.880	0.700	0.129	0.040	0.060
74/02/23	10	53	1.120	0.800	0.075	0.035	0.085
74/03/04	10	00	0.720	0.900	0.045	0.052	0.190
74/04/05	09	30	0.310	0.600	0.030	0.020	0.020
74/04/27	09	30	0.152	1.100	0.045	0.005	0.010

STORET RETRIEVAL DATE 75/02/03

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 392121          A=392121      PB03000
41 20 34.0 073 44 18.0
VILLAGE OF CORTLAND
36155   7.5 CORTLAND
D/MOSQUITO CREEK RESERVO
MOSQUITO CREEK RESERVOIR
RESALES                  2141204
4                        0000 FEET  DEPTH
```

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50050 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/09/11	00 00								
CPIT)-			0.460	15.000	5.000	9.700	10.100	0.222	0.246
73/04/11	09 00								
73/10/17	13 30		12.600	2.200	0.010K	6.400	10.500	0.293	0.275
73/11/14	14 30		1.300	18.000	2.600	5.200	9.900	0.315	0.372
73/12/14	07 30		2.100	14.000		4.200	6.400	0.503	0.347
74/01/16	17 52		9.100	2.100	0.330	3.000	4.000	0.732	0.399
74/02/13	06 15		3.500	13.000	1.520	4.100	6.900	0.476	0.421
74/03/25	16 30		0.520	8.000	0.079	2.000	4.400	0.629	0.690
74/04/27	12 30		0.200	13.000	1.650	3.000	6.000	0.057	0.664
74/08/07	07 30		5.300	3.500	0.050K	5.600	5.200	0.424	0.462
74/03/30	10 30		0.080	8.000			3.400	0.425	0.467
74/09/25	20 25		9.600	4.000	0.120	5.400	4.950	0.475	0.451

K VALUE KNOWN TO BE
LESS THAN INDICATED